CLAIMS:

1. An optically encoded particle (10, 10a) library production method, comprising:

selecting one of a set of computer controlled waveforms; and

applying the one of a set of computer controlled waveforms during etching of material to produce a particle of the particle library from the material, the particle of the particle library comprising,

a porous layer having a refractive index versus depth profile uniquely corresponding to the one of a set of computer controlled waveforms, the refractive index versus depth profile producing a unique interference pattern in the reflectivity spectrum that forms an optical signature corresponding to the one of a set of computer controlled waveforms.

2. The particle library production method of claim 1, wherein the particle has a diameter of hundreds of microns or less.

3. The particle library production method of claim 1, wherein said interference pattern in the reflectivity spectrum extends beyond the visible spectrum.

4. The particle library production method of claim 1, conducted to form a first porous layer and n additional porous layers, wherein said first porous layer and said n additional porous layers alternate periodically and form a Bragg stack.

5. The particle library production method of claim 1, conducted to form a first porous layer and n additional porous layers, wherein said first porous layer and said n additional porous layers form a Rugate reflector.

6. The particle library production method of claim 1, wherein the material comprises a semiconductor.

7. The particle library production method of claim 6, wherein said semiconductor comprises silicon.

8. The particle library production method of claim 1, wherein the material comprises an insulator.

9. The particle library production method of claim 1, further comprising a receptor for binding a predetermined analyte.

10. An optically encoded particle (10, 10a), comprising a thin film in which porosity varies according to one of a library of computer controlled waveforms in a manner to produce a one of a library of codes detectable in the reflectivity spectrum.

11. The particle of claim 10, used an assay detection method including a step of detecting a spectral shift

12. The particle of claim 10, further comprising a receptor.

13. The particle of claim 12, wherein said receptor is a receptor for a biological analyte.

14. The particle of claim 12, wherein said receptor is a receptor for a chemical analyte.

15. The particle of claim 12, wherein said receptor is a receptor for a gaseous analyte.

16. The particle of claim 10, further comprising a fluorescence tag for assaying the particle.

17. The particle of claim 10, wherein the thin film comprises porous silicon.

18. The particle of claim 10, being micron-sized.

19. A method for encoding thin films, comprising steps of:

etching a semiconductor or insulator substrate to form a thin film including pores;

varying etching conditions in accordance with one of a set of computer controlled waveforms to create a refractive index versus depth profile that creates a pattern that will generate a recognizable code in the reflectivity spectrum in response to illumination.

20. The method of claim 19, further comprising a step of separating the thin film from the semiconductor or insulator substrate.

21. The method of claim 20, further comprising a step of separating the thin film into particles.

22. The method of claim 21, further comprising a preliminary step of masking the semiconductor or insulator substrate to define a pattern to define shapes in the particles when they are separated from the thin film.

23. The method of claim 19, further comprising steps of:

generating an interference pattern in the reflectivity spectrum by illumination of one or more of the particles;

determining a particle's code from the interference pattern.

24. The method of claim 19, further comprising a step of spatially defining the semiconductor or insulator substrate to conduct said step of etching in a spatially defined location or locations.

25. The method of claim 24, wherein said step of varying further varies etching conditions in different spatially defined locations to encode multiple codes in the thin film.

26. The method of claim 25, further comprising a step of separating the thin film from the semiconductor or insulator substrate.

27. The method of claim 26, further comprising a step of separating the thin film into particles.

28. A method for identification of an analyte bound to an encoded particle or identification of a host including an encoded particle of claim 10, the method comprising steps of:

associating the encoded particle with the analyte or the host;

generating an interference pattern in the reflectivity spectrum by illumination of the particle;

determining the particle's code from the interference pattern;

identifying the analyte or the host based upon said step of determining.

29. The method of claim 28, further comprising a step of designating the particle to bind an analyte by modifying the particle with a specific receptor or targeting moiety.

30. The method of claim 29, wherein the targeting moiety is a sugar or polypeptide.

31. The method of claim 30, further comprising a step of signaling binding of an analyte by fluorescence labeling or analyte autofluorescence.

32. A method of encoding micron sized particles, the method comprising steps of:

etching a wafer to form a thin film having a varying porosity that will produce a detectable optical signature in response to illumination, the optical signature being selected from a library of optical signatures;

applying an electropolishing current to the wafer to remove the porous film from the wafer;

dicing the film into micron-sized particles, each micron-sized particle maintaining an optical signature produced by said step of etching.

33. The method of claim 32, further comprising a step of modifying the particles with a specific receptor or targeting moiety.

34. An encoded micron-sized particle (10, 10a) having a code from a library of codes embedded in its physical structure by refractive index changes between different regions of the particle.

35. The encoded micron-sized particle of claim 34, wherein the refractive index changes result from a varying porosity.

36. The encoded micron-sized particle of claim 34, wherein different regions of the particle have different thickness.

37. The particle of claim 34, further comprising a receptor.

38. The particle of claim 37, wherein said receptor is a receptor for a biological analyte.

39. The particle of claim 37, wherein said receptor is a receptor for a chemical analyte.

40. The particle of claim 37, wherein said receptor is a receptor for a gaseous analyte.

41. The particle of claim 37, further comprising a fluorescence tag for assaying the particle

42. The particle of claim 34, wherein the thin film comprises porous silicon.

43. An optically encoded particle (10, 10a), comprising a porosity whose optical reflectivity spectrum can be recognized as a distinct interference pattern from one of a library of patterns for the purposes of distinct identification of said particle and for identification of a spectral shift in the presence of an analyte.

44. A method of recognizing the particle of claim 43, the method comprising conducting a principle components analysis to match the optical reflectivity spectrum to the one of the library of patterns.